REMARKS

Claims 41-43 were indicated allowable and are presumed allowable. New claims 44-50 are patentable over the prior art of record.

Claims 36-40 were rejected under 35 U.S.C. § 103(a) over Gilbertson in view of Tomaro and Nosenchuck. Claim 42 was rejected under 35 U.S.C. § 103(a) over Gilbertson in view of Tomaro, Nosenchuck, Rose and Clemens. The pending claims are patentable for the following reasons.

The Prior Art

The cited patents by Tomaro, Gilbertson and Nosenchuck are discussed below.

Tomaro teaches a multispeed hair dryer with a heating element and a motor driven fan for delivering hot air from the drier

Gilbertson's patent is for an invention of a dryer that is to be "useful where the area to be dried is relatively small, such as in the field of dentistry wherein a tooth or teeth are to be dried prior to work thereon." Application of Gilbertson to hand drying would result in an inoperative embodiment, because it is intended for use as a hand held device and for small areas and it is not obvious why using a larger and heavier blower and motor could be used and accepted in a hand held device. This present invention describes an embodiment that provides the necessary force and temperature of air stream from a wall mounted device and at an extended distance and for an extended area and thus constitutes a new non-obvious invention.

Nosenchuck describes a hair dryer and describes how the dimensions of the ducts can be determined knowing the desired exit velocity. In the Nosenchuck invention the ducts were chosen using routine experimentation and "the profile is chosen empirically to inhibit flow separation from the internal duct walls."

Nosenchuck teaches that "Then the flow envelope is a cubic function, that is d=f(x.sup.1/3), where d is the diameter of the main housing and x is the axial distance along the housing. The outer duct 24 is also configured as a cubic function of the axial distance along the duct. This profile is chosen empirically to inhibit flow separation from the internal duct walls."

In contrast to Nosenchuck, flow separation from the internal duct walls is not a factor in embodiments of the invention. Also the cylindrical exit nozzle does not involve a "... cubic function, that is d=f(x.sup.1/3), where d is the diameter of the main housing and x is the axial distance along the housing." The diameter of the tubular nozzle in the invention has a constant diameter.

Nosenchuck teaches dependence of heat output of the dryer upon mass flow rate and air outlet temperature. Heat output is not a factor in the blow off of loose water on the hands by a forceful air flow at the remote location of the hands which is a feature of the present invention. And it is only one factor in the evaporation of water by heat which also is enhanced by a high velocity flow that breaks up stagnation boundary layers that reduce evaporation by the back flow of water evaporated into the stagnation boundary layer.

Embodiments of the Invention

The concept of stagnation boundary layer is known and the prior art teaches that evaporation of water molecules into the stagnation layer results in an accumulation of water molecules – a stagnating – therein, thus reducing the net rate of evaporation. Furthermore, the prior art does not teach how to breach said boundary layer in a continuous process as is accomplished in this invention, Breaching said boundary layer avoids back flow from said water into said layer with the result that evaporation rate is enhanced. Sweeping the boundary layer away by a sufficiently forceful air flow removes the water molecules that might otherwise return to and remain on the surface.

Those knowledgeable in the art of hair drying will not necessarily be knowledgeable in the art of hand drying because drying of water held in capillary action between strands of hair is physically different from drying of water on the surfaces of hands.

The present invention is used to dry hands rather than hair or teeth and uses faster forceful air velocity (rather than just maximum mass flow) - and is for this new application. This invention represents the <u>combination</u> of forceful heated air flow, plus a tubular nozzle that maintains the directionality, forceful flow, and hot air temperature at the remote location of wet hands – a new application and a novel approach. This forceful

air flow is maintained through the entire drying cycle. It accomplishes three results not seen in conventional hand dryers. (1) In the first third of that cycle – about three seconds- it blows away more than eighty percent of the water, namely the "loose" water, that water which is not bound to the skin of the hands. It accomplishes this mechanically, by blasting, and not by evaporation. It takes far less energy to blow away water than to evaporate it. In the final two thirds of the cycle its force is used (2) to break away the stagnation boundary layer, thus eliminating stagnation and enhancing the speed of evaporation. The evaporation is further enhanced by the high temperature – around 130°F – maintained (3) through the entire length of the air stream as far as 4 inches from the air exit.

Conventional hand dryers never have an air stream as powerful as the invention's and thus achieve virtually no blowing away of water. Thus they must rely entirely on evaporation to remove water. By the same token, their air streams are not powerful enough to reduce the stagnation barrier layer which slows down the evaporation process. Finally their air streams are not powerful enough to maintain high temperatures at the remote distance where hands are positioned. Room air entrainment dilutes these comparatively gentle air streams and they generally are not warmer than 110°F by the time they reach the hands. Hotter air, even on twenty degrees, means faster evaporation. These three factors are the reason why the invention dries hands three times faster and with three times less energy than conventional hand driers. The use in combination of these factors is not obvious and warrants patenting.

In selecting the characteristics of the nozzle to be used in the invention for improved drying, the analog of obtaining maximum power from a voltage source which has internal resistance was used by the inventors. If the load resistance is set to zero or close to zero the current is limited to the short circuit current and is determined by the ratio of the open circuit voltage to the internal resistance. The product of high short circuit current and low load voltage is close to zero. In the open circuit mode the current is zero (by definition) and when multiplied by the open circuit voltage is also zero. There is a condition for obtaining maximum power to the load and this corresponds to the case where the load is selected to give half of the closed circuit current. Thus the inventors

did not need systematic experimentation to determine a satisfactory nozzle design, but just data collection to demonstrate the improved performance.

To show that systematic experimentation was not needed, the inventors used the concept of load matching in the consideration of the solution to faster drying, and selecting nozzle impedance for better use of the available pressure and flow of a blower, the nozzle dimensions were computed and tested to be those that reduced the output air flow to about half the maximum output of the blower. To maintain directionality of the exiting air flow, the nozzle was made long compared to the dimensions of the nozzle opening. Also, based upon experience with vacuum system tubing, it was known that the effective diameter of a tubing decreased with tubing length. The inventors started with a nozzle diameter of about one inch which is about the diameter of other dryers, but increased the impedance of the nozzle by making it longer by about a factor of about 4 which also provided improved directionality of the air flow. A tubular circular nozzle rather than other shapes was used because air entrainment of room air is reduced when the periphery is minimized. Entrainment of room air was reduced because it was felt to reduce the force and temperature in the exiting air thus reducing the effectiveness in hand drying. This is one of the limitations of other hand dryers even those with circular openings without a tubular structure.

When drying data were collected (using a mass-produced blower as the source), it was found that the original design provided the desired improved drying. In order to demonstrate that the new invention design is an improvement and close to the optimum, the inventors collected data comparing drying as a function of time for a number of competitive dryers. The inventors also collected data verifying the predicted preservation of blowing force and temperature as a function of distance from the air exit. This was necessary to show that when hands are rubbed and rotated at the necessary distance from the exit there was the desired force and temperature in the forceful directional air flow. Systematic experimentation was not needed because the knowledge of the inventors was able to identify satisfactory design conditions.

Thus, the data demonstrated that the invention is better than competitive dryers from the point of view of drying time. Also the data demonstrated the retention of much of the air flow force and temperature at the remote location to be used in drying hands.

Knowledge in a different art, the art of aerodynamics indicated that a tubular nozzle with a length greater than cross section dimensions would provide improved directionality of the exiting air flow in order to maintain air flow force at the remote location of the hands. The hands must be located at a distance from the nozzle exit in order to permit rotation and wiping of the hands during drying and for better drying

The methods disclosed in the specifications and in the claims are for a means of providing a forceful flow of heated air that is effective in blowing loose water off the wet hands and also capable of breaking up the normally slow boundary layer of air adjacent to the surface of the hands. By reducing the boundary layer of stagnation air, the films of remaining water on the surfaces are able to evaporate more quickly.

Because the hands have a large surface area and must be located remotely from the air exit nozzle, there must be a means to reduce the effect of room air entrainment which otherwise would reduce the blowing force and heat of the exiting air at the location of the wet hands. This is done in the invention by using the circular shape of the exit nozzle to reduce the circumference so as to reduce air entrainment.

The observation that the hands during the early stage of the evaporation feel cool and is different from the usual air hand dryers shows that the evaporation and evaporation cooling is greater because of the reduction of the stagnation boundary layer which normally slows evaporation. Note that the term stagnation boundary layer applies to the slowly moving air adjacent to the skin and does not apply to the film of water on the hand below the boundary layer.

Prior public teaching does not discuss the effect of stagnation boundary layer in connection with fast drying of hands or teeth or of hair. It should be noted that the physics associated with drying of hair and the physics of drying of hand surfaces are very different. The water to be dried from wet hair is mostly held by capillary action between the hair strands, and only when the outer hairs are dried and blown away does the hot air have access to the water in the inner strands. Drying of hand surface water is different from drying of capillary held water.

The figures in the patent application do not represent systematic experimentation but were included to demonstrate that the drying time for the invention as indeed faster than other hand dryers and the curves were provided to show that the drying performance

degraded when the design differed from the design features in the present invention. Data was also provided to support the claim that the present invention provided forceful and warm air flow at a distance compatible with average placement and distance of the hands during drying. Drying of relatively small teeth at a close distance with a hand operated source of air is different from drying larger area hands at a larger distance using a stationary blower.

Benefits of Embodiments of the Invention

The benefits that result from faster and more effective drying include the following.

1. That it provides faster, more complete and more comfortable drying. Includes: (a) User satisfaction that derives from not having to wait for a half minute or more and not having to repeat the cycle when hands are still wet. (b) User satisfaction from having hands completely dry in fifteen seconds or less (c) User satisfaction from the feeling of warmth and comfort after using the invention.
2. That it is immediately accepted by first time users. Even as a newly introduced product, it is widely accepted with continuously growing sales, in spite of a higher price
3. Increased saving in energy due to use of power for a shorter time. Saving is considerable, running between two thirds and three quarters
4. Because of its superior performance it opens a major segment of the market since it has not previously been accepted by high end commercial establishments
5. As the market expands environmental benefits in less paper and landfill use and decreased labor costs in refilling and disposal of towels will decrease proportionately.

As was stated previously there are other benefits:

(a) User satisfaction that derives from not having to wait for a half minute or more and not having to repeat the cycle when hands are still wet,

(b) User satisfaction from having hands completely dry in fifteen seconds or less,

(c) User satisfaction from the feeling of warmth and comfort after using the Invention

(d) Increased saving in energy due to use of power for a shorter time,

(e) Increased saving in operating costs such as towels and labor,
(f) Encouraging the number of people washing of hands in public bathrooms because of the faster drying provided,
(g) Contribution to preservation of health because encouraging washing.

The invention reduces energy consumption by over 60 percent because of shorter operation during drying and reduced need to turn on dryer again to improve drying.

Less energy and energy cost in the invention results because the dryer only needs to operate for about 10 to 15 seconds which is a factor of three shorter than the 30 to 45 seconds employed by other hand dryers. The unit operates from the same 120 volt line as the others and draws about the same power while operating. Thus one of beneficial factors is the reduction of energy cost and operating cost by about 66 percent. Other benefits, shared with other dryers, are the reduced use of paper towels, less load on land fills, and preservation of trees. However, because of the better drying and faster drying of the invention, users will more frequently use the dryer, will avoid the choice of paper towels, will wash their hands more readily this reducing the chance of infection, and will not need to wipe their hands on clothing after incomplete drying thus possibly requiring bacteria, and being unkind to their clothing. The saving of user time by faster drying is another benefit. The only possible drawback is the increased noise produced when the directional forceful flow of air impacts the hands, but many find this is an attraction and demonstrating of its power.

Hands are truly dry and comfortable thus reducing the tendency and inclination to dry the hands on the clothing. This benefits the clothing, and reduces the chance of picking up bacteria from wiping the cleaned hands on possibly less clean clothing. Encourages the washing of hands in public bathrooms because if the more acceptable drying time. This helps in reducing infections.

The invention reduces the use of paper towels this reducing the cost of labor for replenishing the supply of towels, reduces the load on land disposal sites, and reduces the cutting of tree to make paper towels.

Evidence of Long Felt Need

During prosecution of this application, Applicants submitted a Declaration by Denis Gagnon on August 30, 2002 establishing a long felt need in the industry for a dryer having characteristics provided by the claimed invention. There is a long felt need in the dryer industry for a dryer that provides rapid, complete and comfortable drying.

Errors were made by the Board of Appeals and Patent Interferences in interpreting the Declaration. In analyzing the Wall Street Journal article submitted as Exhibit 1 to the Declaration, the Board states that the long-felt need "has already been fulfilled by a different patented product." The reference in the WSJ article is to the invention, which is sold under the trade name XLerator, not to a different patented product. There is no other product that meets this long felt need. Thus, citing XLerator as different from the embodiments of the invention is factual error. Embodiments of the invention, as embodied one or more pending claims, correspond to the commercial XLerator hand dryer.

Furthermore, in analyzing the Maintenance Supplies article (Exhibit 2 of the Declaration) the Board stated that nine out ten people opt for papers towels "indicates another patented device to satisfy the long felt need." Paper towels do not satisfy the long felt need for an air based hand dryer that dries the hands quickly and leaves the user's hands warm. The long felt need is not merely drying hands, but an air based hand dryer that works quickly and comfortably.

Lastly, in analyzing in Environmental Building News (Exhibit 3 of the Declaration) the Board notes that the product referred to as "XLerator" generates too much noise. Embodiments of the invention are sold under the XLerator brand name. The fact that the early versions did generate noise does not mean that the invention fails to satisfy the long felt need for an air based hand dryer that works quickly and comfortably.

It is important to be noted that the present invention was licensed exclusively in the field of use of hand drying to Excel Dryer by Invent Resources, Inc. (identified in the Wall Street Journal article and in other articles). The XLerator cited in the brief all refer to the same present invention and device.

The Gagnon declaration included exhibits 1, 2, and 3 to show that the industry supports a long felt need for a faster hand dryer. Improved dryers cited in the exhibits

actually are the Excel XLerator dryers based upon the present invention licensed and assigned to Excel Dryer Inc. by the inventors of the present invention.

Conclusion

In view of the foregoing amendments and remarks, Applicants submit that this application is in condition for allowance. Early notification to this effect is requested.

If there are any fees due in connection with this response, please charge such fees to deposit account 06-1130 maintained by Applicants' attorneys.

Respectfully submitted,

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